Pressures analysis in the Tisza River Basin Reference years 2006 / 2007

icpdr iksd

International Commission for the Protection of the Danube River

Internationale Kommission zum Schutz der Donau

Annex 3 of the ITRBM Plan

Deutschland //// Österreich //// Česká republika //// Slovensko //// Magyarország //// Slovenija //// Hrvatska //// Bosna i Hercegovina //// Србија //// Crna Gora //// România //// България //// Moldova //// Україна

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Introduction

At the ICPDR Ministerial Meeting in 2004, the representatives of the five Tisza countries signed the Memorandum of Understanding to develop a River Basin Management Plan for the Tisza River. This plan represents one of the first sub-basin initiatives of the ICPDR directed to support sustainable development of the region. It closely follows the requirements of the Water Framework Directive (WFD; 2000/60/EC) which requires Member States to regularly publish river basin management plans.

This paper presents the **concept, methodology and results of pressures assessment** performed for the Tisza River Basin Management Plan **for each of the Significant Water Management Issues in the TRB: organic pollution, nutrient pollution and hazardous substance pollution**, and it includes pressures from **point and diffuse sources of pollution.**

On short, the **overall methodology for pressures assessment for organic, nutrients and hazardous substances pollution** includes following activities:

(1) Collection, collation, assessment and presentation of information in a report on the pressures in the Tisza River Basin

1. Making use of the knowledge, data and information used in the preparation of the Danube River Basin Management Plan and Tisza Analysis Report
2. Adapt the concept of pressures assessment to the needs of the present ToR, specifically to the requirement to consider the role of wetlands in reducing the nutrients in the Tisza River Basin.
3. Adjust the data collection for performing the pressures assessments for the Danube River Basin, to the TRB needs, in terms of scale, data availability and specificity of the TRB, such as the weight of mining industry and the industrial pressures assessment.
4. Perform the pressures assessment
5. Scenario for Program of Measures in the TRB: Definition of scenario in line with the TRB management objectives and visions. Calculation of scenario and presentation of results.
6. Elaboration of the Report on the results of the assignment performance.

(2) Assistance with providing data, assessment and presentation for indicators developed for the main UNDP/GEF project.

(1) Definition of indicators for defining baseline and anticipated nutrient reduction scenarios relating to changes in wetland/floodplain reconnection and land use within the Tisza River Basin, in agreement with the Tisza countries and PIU.

(2) Execution of the MONERIS model to assess the changes in nutrient loads as a result of changes in wetland/floodplains and land use (this should take account of the results of the UNDP/GEF Danube Regional Project outputs from Components 1.4 and 4.3.

(3) Assistance to the MSP Project Implementation Unit with on-going pressure assessments through out 2009 as required.

To assist the MSP Project Implementation Unit with on-going pressure assessments through out 2009 as required, the concept and pressures assessment will be performed according to the agreed methodology. The detailed methodology for each of the assigned tasks is presented in the Inception Report submitted in June 2009.

Through the dialogue with the members of both P&M EG and Tisza group as well the PIU and the Secretariat, and also based on information provided by the project team, acceptance from the Tisza countries will be permanently requested and comments accordingly incorporated. Further, through this assignment is also planned to provide feed back and recommendation to the project team, to allow share of information and transfer of lessons.

During project implementation it is agreed with the members of both P&M EG and Tisza group to make sure that timely deliverance of data, comments to the data assessments and feed back to the drafts prepared will be ensured.

Finally, the project team is looking forward to receive suggestions and recommendations from the ICPDR and MSP project teams, along the implementation of this assignment.

1. Organic pollution

According to the WFD requirements, the river basin management plans should include a summary of anthropogenic pressures and impacts of human activity on the status of surface water and groundwater.

The major cause of organic pollution is insufficient or lack of treatment of wastewaters discharged by municipalities, agricultural point sources (animal breeding farms, manure depots, etc.) and industrial point sources. Organic pollution contributes greatly to unbalanced plant growth in water, and therefore it influences the nutrients input into the river systems.

The discharge of partially treated or untreated wastewater from urban areas is especially significant and does not meet the requirements of relevant EU legislation, in particular the EU Urban Wastewater Treatment Directive (UWWTD) and the Directive for Integrated Pollution Prevention and Control (IPPC Directive). Significant water pollution problems still persist at present throughout a large part of the basin despite on going implementation of EU and national policies in most of the Danube countries.

Another important cause of organic pollution is insufficient or lack of treatment of wastewaters discharged from agricultural point sources (animal breeding farms, manure depots, etc.) and from industrial point sources.

The pressures assessment for point and diffuse sources of pollution in the TRB follows the same approach as for the development of the Danube River Basin management Plan.

1.1. Organic pollution from urban wastewater

1.1.1. Basic concept

One fraction of the anthropogenic pressures is wastewater emissions from municipal sources that include significant loads of organic pollutants (BOD5 (5-day biochemical oxygen demand) and COD (chemical oxygen demand)) and nutrients (nitrogen (N) and phosphorus (P)).

Since 1997, the ICPDR has prepared inventories on point source emissions including emissions from municipal sources, with the existing wastewater treatment plant being the core element of the inventory. In 2006, the ICPDR Municipal Emission Inventory was modified in order to be consistent with the collection of data under the Urban Wastewater Treatment Directive (UWWT Directive; 91/271/EEC). In contrast to former Emission Inventories, it is now the *agglomeration*[1], which represents the core element of the inventory. This approach has the advantage of including those municipal areas where no collecting system and/or wastewater treatment plant is yet in place, which is still the case in the TRB.

According to the data model of the UWWT Directive, the data model of the ICPDR Municipal Emission Inventory concluded in 2009 for TRB considers the following relation between agglomeration, UWWTP / collecting system without treatment and discharge point (see also Figure 1):

- **One agglomeration** can be served by **one or no UWWTP / Collecting system without treatment** (relation 1:1);
- **One agglomeration** can be served by **several UWWTPs / Collecting systems without treatment** (relation 1:n);
- **Several agglomerations** can be connected to **one UWWTP / Collecting system without treatment** (relation m:1)
- **One UWWTP Collecting system without treatment** discharges wastewater by **one** (relation 1:1) **or several discharge points** (relation 1:n)

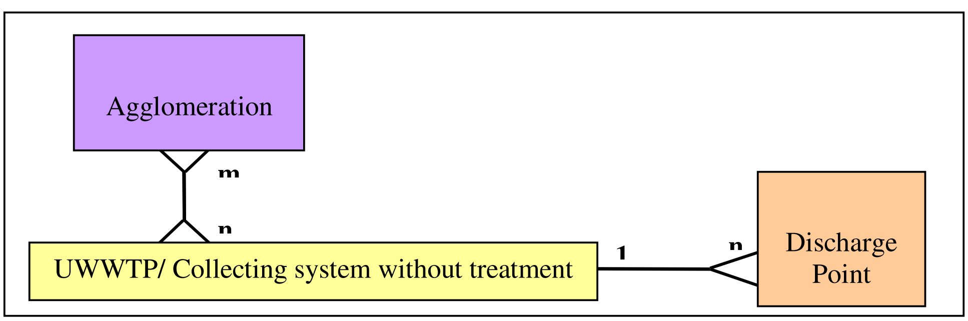


Figure 1: Data model under TRB Emission inventory 2009 (according to the ~~data model under Article 15 of~~ Directive 91/271/EEC)

[1] 'Agglomeration' means an area where the population and/or economic activities are sufficiently concentrated for urban wastewater to be collected and conducted to an urban wastewater treatment plant or to a final discharge point (Directive 91/271/EEC).

Besides this general relation between agglomeration, UWWTP / Collecting system without treatment and discharge point, the second important parameter to consider is the pathway of wastewater from the agglomeration to discharge to the environment. The main pathways of wastewater from an agglomeration can be described as follows:

- Collection in a collecting system (= system of conduits) and treatment in an UWWTP;
- Collection in a collecting system (= system of conduits) and discharge without treatment (in the Municipal Emission Inventory 2009 this situation is presented by so called "NOWWTP" referring to a "Collecting system without treatment");
- Collection in individual and appropriate systems (e.g. cesspools) and transport to an UWWTP by truck;
- Discharge without collection and treatment.

These possible pathways are described in Figure 2 in more detail:

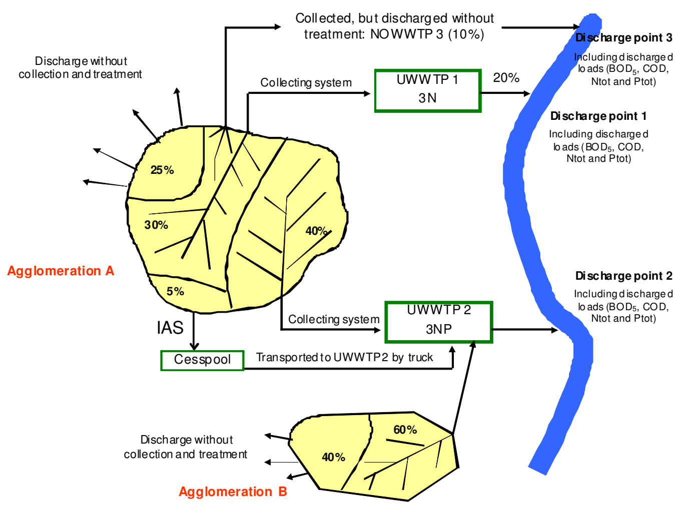


Figure 2: Major pathways of wastewater from agglomerations as covered by the Municipal Emission Inventory 2009 for TRB

1.1.2. Methodology for data evaluation and pressures analysis

The Municipal Emission Inventory 2009 for TRB template follows the same concept as the data collection templates for the Danube RBM Plan. It considered the principal data model and the different possible pathways in the following way: the link between agglomerations, UWWTPs/NOWWTPs and discharge points is provided by defining unique codes (IDs) for each object and linking these IDs in the different templates. The different wastewater pathways are covered by the following parameters:

- Template agglomerations: % of generated load collected in a collecting system (estimate);

  % of generated load collected but discharged without treatment;

  % of generated load addressed through individual and appropriate systems (IAS);

  % of generated load not collected in collecting system and not addressed through individual and appropriate systems (IAS).

- Template UWWTPAgglo.: % of the generated load of the agglomeration treated in this UWWTP.

Example: The situation described in Figure 2 is reflected in the templates as follows:

Template agglomerations:

ID of agglo-meration	Name of agglomeration	Generated load (p.e.)	% of generated load collected in a collecting system	% of generated load collected in a collecting system, but discharged without treatment	% of generated load adressed through individual and appropriate systems (IAS)	% of generated load not collected through collecting systems and not adressed through IAS
MS_AG_A	Agglomeration A	31.000	70	10	5	25
MS_AG_B	Agglomeration B	20.000	60			40

Template UWWTPs:

ID of UWWTP/ collecting system without treatment	Name of UWWTP/ collecting system without treatment	Type of treatment	Organic design capacity (p.e.)	Primary treatment	Secondary treatment	More stringent treatment with N-removal	More stringent treatment with P-removal
MS_UW_1	UWWTP 1	UWWTP	50.000	Y	Y	Y	N
MS_UW_2	UWWTP 2	UWWTP	70.000	Y	Y	Y	Y
MS_NOW_3	NOWWTP 1	NOWWTP		N	N	N	N

Template UWWTPAgglo:

ID of UWWTP/ collecting system without treatment	ID of agglomeration served	% of the generated load of the agglomeration treated in this UWWTP
MS_UW_1	MS_AG_A	20
MS_UW_2	MS_AG_A	45
MS_UW_2	MS_AG_B	60
MS_NOW_3	MS_AG_A	10

For data evaluation for the Municipal Emission Inventory 2009 for TRB countries the following issues were considered:

1. Only agglomerations with a generated load ≥2000 PE were considered for data evaluation.
2. For EU MS, data reported under TRB inventory is identical to information reported under the UWWT Directive Article 15 (Questionnaire 2007). All three MS in the TRB provided information under Tisza EMIS 2009 by the 1 July 2009 using updated templates.
3. It was investigated whether all agglomerations (where a specific % is collected in a collecting system) were linked to at least one UWWTP/NOWWTP and whether all UWWTPs/NOWWTPs were linked to at least one discharge point via IDs. In cases where the link via IDs was not established, efforts were taken to define the link via names of agglomerations, UWWTPs/NOWWTPs and discharge points.

   In cases where a UWWTP/NOWWTP could not be linked to a discharge point, the discharged loads from this UWWTP/NOWWTP were estimated according to the method described under point 7.

   In cases where an agglomeration could not be linked to any UWWTP/NOWWTP and where the parameter "*% of generated load collected in a collecting system*" was 0, then it was assumed that the total generated load of this agglomeration was not collected and discharged without treatment.

   In cases where an agglomeration could not be linked to any UWWTP/NOWWTP where the parameter "*% of generated load collected in a collecting system*" was not 0, then it was assumed that the generated load of this agglomeration collected in a collecting system is discharged without treatment. In this case, a NOWWTP was created and discharged loads were calculated for this NOWWTP.
4. Besides the link between agglomerations, UWWTPs/ NOWWTPs and discharge points via IDs, it is crucial to know which fractions (=% of the generated load) enter the different wastewater pathways. In cases where this parameter was not reported in EMIS 2009 by EU MS, this information was taken over from the UWWT Questionnaire 2007. In cases where the parameter *"% of the generated load of the agglomeration treated in this UWWTP"* was not given for a UWWTP/NOWWTP in the Non EU MS, this parameter was considered as identical to the parameter "*% of generated load collected in a collecting system" and/ or "% of generated load collected but discharged without treatment"* (in cases where NOWWTPs were reported).
   In cases where these parameters were also not reported, then the parameter *"% of population connected to combined sewage network*" and/or the parameter *"% of population connected to separate sewage network*" were taken into consideration. In cases where no information was reported for all the above mentioned parameters, a default value of 75% was used for the parameter "% of generated load collected in a collecting system".
5. Under the UWWT Directive, one wastewater pathway covers the generated load addressed through individual and appropriate systems (IAS). Wastewater addressed through IAS can be treated locally (e.g. domestic sewage treatment plant) or transported to a treatment plant (e.g. collected in a cesspool and then transported to a UWWTP by truck). In the TRB EMIS 2009, it was foreseen that the fraction of the generated load collected in a cesspool and transported to an UWWTP by truck is included in the

parameter "% of the generated load of the agglomeration treated in this UWWTP" in the template UWWTPAgglo. In cases where this parameter was not reported but a specific fraction of the generated load was reported to be addressed through IAS, then it was assumed that the emissions from the UWWTP already covered the generated load of the connected agglomeration addressed through IAS. In cases where no UWWTP / Collecting system without treatment was connected to one agglomeration, but a specific fraction of the generated load was reported to be addressed through IAS, emissions of BOD_5, COD, N_{tot} and P_{tot} were calculated separately.

6. In cases where more than one agglomeration was connected to one UWWTP/NOWWTP, the emissions (BOD_5, COD, N_{tot} and P_{tot}) reported for the discharge-point connected to this UWWTP/NOWWTP was allocated to the different agglomerations. Allocation was done under consideration of the generated load of the agglomerations (PE) and the percentage of the generated load treated in the UWWTP/NOWWTP.

7. In cases where emissions for BOD_5, COD, N_{tot} and/or P_{tot} were missing, this data was calculated by using estimation factors, considering the generated load of the agglomeration (PE), the percentage of the generated load treated in the UWWTP/NOWWTP connected to this discharge point and the type of treatment in the UWWTP/NOWWTP.

   In a first step, the generated loads were calculated based on estimation coefficients used as well for the Danube pressures analysis:

BOD_5	60 g/PE/day
COD	110 g/PE/day
N_{tot}	8.8 g/PE/day

   Calculation of generated loads of total P for reference date 31/12/2005 or 31/12/2006 took into account the fact that all countries in the TRB have not yet introduced P-free detergents. For this reason, country specific coefficients were used to estimate the generated loads of P_{tot} per population equivalent. On the basis of country-specific P emissions per inhabitant and per day, the following estimation coefficients were taken into account for population equivalents (p.e.). The coefficient for Serbia was reported in the update of information delivered in April 2009.

Country	Coefficient (g P/ (PE d)
Hungary	1.7
Romania	1.5
Serbia	1.8

Country	Coefficient (g P/ (PE d)
Slovakia	1.55
Ukraine	2.05

   For the calculation of future scenarios for the reference year 2015, the use of P-free detergents was assumed for all countries in the TRB. For this reason, total generated loads of total P for the year 2015 were calculated by the use of an estimation coefficient of 1.5 g/PE/day. This value was used in the Danube pressures assessment, based on the value reported by Austria, where P-free detergents have been used for several years.

   In a second step, discharged loads were calculated on the basis of generated loads and treatment type:

No treatment	Generated loads are reported as discharged ones.
Primary treatment	BOD_5 reduction: 20% (UWWT Directive [91/271/EEC]) COD reduction: 25% (DRBMP) N_{tot} reduction: 9% (DRBMP) P_{tot} reduction: 10% (DRBMP)
Secondary treatment	BOD_5 reduction: 70% (UWWT Directive [91/271/EEC]) COD reduction: 75% (UWWT Directive [91/271/EEC]) N_{tot} reduction: 35% (DRBMP) P_{tot} reduction: 20% (DRBMP)
More stringent treatment	BOD5 reduction: 95% (DRBMP) COD reduction: 85% (DRBMP) N_{tot} reduction: 70% (UWWT Directive [91/271/EEC]) P_{tot} reduction: 80% (UWWT Directive [91/271/EEC])

As result of these calculations, discharged loads of BOD_5, COD, N_{tot} and P_{tot} were available for all UWWTPs/NOWWTPs.

8. The type of treatment was defined for each agglomeration. In cases where an agglomeration was served by more than one UWWTP/NOWWTP, UWWTPs/NOWWTPs with the same treatment level were grouped together and the respective percentage values for the *generated load of the agglomeration treated in this UWWTP* were summarised.

Example: Agglomeration 1:

The generated load (PE) is served by

UWWTP 1 4% primary treatment
UWWTP 2 20% secondary treatment
UWWTP 3 60% primary treatment
UWWTP 4 16% no treatment

primary treatment 64%
secondary treatment 20%
no treatment 16%

After grouping treatment levels for each agglomeration, the definition of treatment types was undertaken as described in the table below. In each case, the highest treatment type available was considered for the purpose of definition of the treatment type.

≥80% of an agglomeration treated in a UWWTP with 3NP, 3N or 3P	More stringent treatment
<80% of an agglomeration treated in a UWWTP with 3NP, 3N or 3P	Partial more stringent treatment

≥80% of an agglomeration treated in a UWWTP with 2	Secondary treatment
<80% of an agglomeration treated in a UWWTP with 2	Partial secondary treatment
≥80% of an agglomeration treated in a UWWTP with 1	Primary treatment
<80% of an agglomeration treated in a UWWTP with 1	Partial primary treatment
Agglomeration treated in UWWTP with no treatment	No treatment

The following example illustrates this approach:

Example: Agglomeration 2:		
50% collected and given primary treatment	→	Partial secondary treatment
10% collected and given secondary treatment		
40% not collected / no treatment		

9. The emissions of BOD_5, COD, N_{tot} and P_{tot} were summarised for all treatment types in a country.
10. For all large agglomerations (≥100,000 PE) in a country, a more detailed analysis of the treatment levels was provided, in that the generated load (p.e.) treated in UWWTPs/NOWWTPs with different treatment levels was indicated.

The first emission inventory in the TRB under this new reporting concept was elaborated in 2009 with the objective of describing the present situation of wastewater treatment and emissions of BOD_5, COD, N_{tot} (total nitrogen) and P_{tot} (total phosphorus) from agglomerations ≥2000 Population Equivalents (p.e.) in the TRB (*reference situation*). In addition, focus was placed on the elaboration of different future scenarios for 2015, taking into account that the Black Sea has been designated as a *sensitive area* due to the need to protect against eutrophication. According to Article 5(5) of the UWWT Directive, it is necessary to identify the catchment area of the Black Sea, and hence the DRB, as the *catchment of a sensitive area*, with its sub-basins, such as TRB, thereby requiring more stringent wastewater treatment in agglomerations with more than 10,000 p.e.

In brief, the different scenarios can be summarised as follows:

- **Reference Situation UWWT 2005/2006 (RefSit-UWWT):** This scenario gives an overview of the current situation regarding wastewater treatment (reference date 31/12/2005 or 31/12/2006) and treatment efficiency in the TRB.
- **Baseline scenario UWWT 2015 (BS-UWWT):** As the Black Sea has been designated as a *sensitive area* due to the need to protect against eutrophication, it is necessary to identify the catchment area of the Black Sea, and hence the TRB, as the *catchment of a sensitive area* according to Article 5(5) of the UWWT Directive. This scenario describes the agreed measures for the first cycle of implementation of the WFD on the basin-wide scale (until 2015). It is based on the assumption that all EU Member States (EU MS) comply with Directive 91/271/EEC, as far as individual

transitional periods require the implementation. For Non EU Member States (Non EU MS), the scenario considers the reported number of wastewater treatment plants with secondary or more stringent treatment to be constructed by 2015.

- **Midterm scenario (MT-UWWT):** This scenario is based on BS-UWWT but assumes that for Non EU MS, P removal is in place for agglomerations >10,000 PE.
- **Vision scenario (VS-UWWT):** This scenario goes beyond the BS-UWWT and the MT-UWWT and therefore far beyond the requirements of UWWT Directive. It is based on the assumption that the full technical potential of wastewater treatment regarding the removal of organic influents and nutrients is exploited for both EU and Non EU MS. If such a scenario was to be realised, it is assumed that agglomerations >10,000 PE are equipped with N and P removal (secondary/tertiary wastewater treatment) and all agglomerations ≥2000 PE are equipped with secondary treatment.

1.1.3. Results of pressures assessment and of scenarios calculations

1.1.3.1. Description of scenarios

The scenarios presented in this report include a description of the current situation of wastewater treatment in agglomerations with at least 2000 p.e. in the TRB at reference date 31/12/2005 or 31/12/2006 (*reference scenario*).

At reference date 2005/2006, 3 EU MS were contributing to the TRB. In two of these countries Slovakia and Hungary, the UWWT Directive had to be fully implemented by 31st December 2015, whereas for Romania the final deadline for compliance is also 31st December 2015, while for smaller agglomerations in Romania only - 2000 PE – 10,000 PE - a final deadline of 31st December 2018 applies. Under Article 5 of the UWWT Directive, two EU MS - Slovakia and Romania designated their entire territory, and Hungary part of their territory, as a *sensitive areal catchment areas of sensitive areas*. Serbia and Ukraine as non EU countries have normal areas only.

The present report additionally describes three future scenarios of wastewater treatment. The *baseline scenario* (BS-UWWT) describes the agreed measures for the first cycle of implementation of the WFD on the Tisza basin-wide scale until 2015. Two additional scenarios, the *midterm scenario* (MT-UWWT) and the *vision scenario* (VS-UWWT) have been developed describing further steps toward the vision for organic pollution as an orientation for future policy decisions.

The scenarios for the development of the urban wastewater treatment in the TRB can be described as follows:

- **Reference Situation UWWT 2005/2006 (RefSit-UWWT):** This scenario gives an overview of the current situation of wastewater treatment (reference date 31/12/2005 or 31/12/2006) and treatment efficiency in the TRB.
- **Baseline scenario UWWT 2015 (BS-UWWT):** This scenario describes the agreed measures for the first cycle of implementation of the WFD on the basin-wide scale (until 2015). Measures that are legally required for EU MS and other measures that can be realistically taken by the Non EU MS have been taken into account.

  As the Black Sea has been designated as a *sensitive area* due to the need to protect against eutrophication, it is necessary to identify the catchment area of the Black Sea as the *catchment of a sensitive area* according to Article 5(5) of the UWWT Directive. Accordingly, the *baseline scenario* was based on the consideration that, under the UWWT Directive, the entire Danube Basin is a *'catchment of a sensitive area'*, with N and P sensitivity, with consequences as well for the TRB. Hence, the following assumptions for measures to be implemented by 2015 were taken:

- ***EU MS with a final deadline of 31st December 2015 to comply with Directive 91/271/EEC:*** For Slovakia and Hungary, it was assumed that Directive 91/271/EEC would be implemented by 2015. Hungary applied Article 5(4) in the TRB. For these areas, it is required that the minimum percentage of the reduction of the overall load entering all UWWTPs is at least 75% for total N and total P. In the cases where no other information was available from the countries, it was assumed for the purpose of this report that, in order to achieve the required removal-rates, N and P removal will be implemented for all agglomerations >10,000 PE, whereas secondary treatment will be implemented in agglomerations ≥2000 PE–10,000 PE. It has to be stressed that this approach does not necessarily reflect the treatment requirements for implementation of Directive 91/271/EEC (the 75% reduction-rate for total N and total P loads may be achieved in the case where not all agglomerations >10,000 PE are treated by N and P removal). However, it serves as interim assumption for the present report in order to calculate forecasted emissions.

- ***EU MS with a final deadline of after 31st December 2015 to comply with Directive 91/271/EEC*** (Romania): While agglomerations with a size >10,000 PE have to comply with Article 3, Article 4 and Article 5(2) by 31st December 2015 at the latest, agglomerations ≤10,000 PE are subject to a transitional period until 31st December 2018. The interim target date to comply with Article 3 (80% of the total biodegradable load of agglomerations of 2000 PE-10,000 PE) and Article 4 (77% of the total biodegradable load of agglomerations of 2,000 PE-10,000 PE) is 31st December 2015. For the purpose of this data evaluation, it was assumed that agglomerations >10,000 PE are served by N and P removal. For agglomerations 2000 PE–10,000 PE, it was assumed that secondary treatment is in place for 77% of the total biodegradable load of agglomerations.

- ***Non EU MS:*** Serbia and Ukraine as Non EU countries were asked for forecasted improvements until the year 2015. In the cases where information was available on agglomeration-level, these data were taken into account for the *baseline scenario*. In the cases where no data was available on agglomeration-level, it was assumed that the situation for wastewater treatment in 2015 would be identical to that in the reference year 2005 or 2006.

- **Midterm scenario (MT-UWWT):** This scenario is based on the baseline scenario. In addition, it assumes for Non EU MS that P removal is in place for agglomerations >10,000 PE in order to achieve the management objectives.

  In order to draft the scenario for the reference year 2015 as realistic as possible, P removal was only considered for agglomerations >10,000 PE.

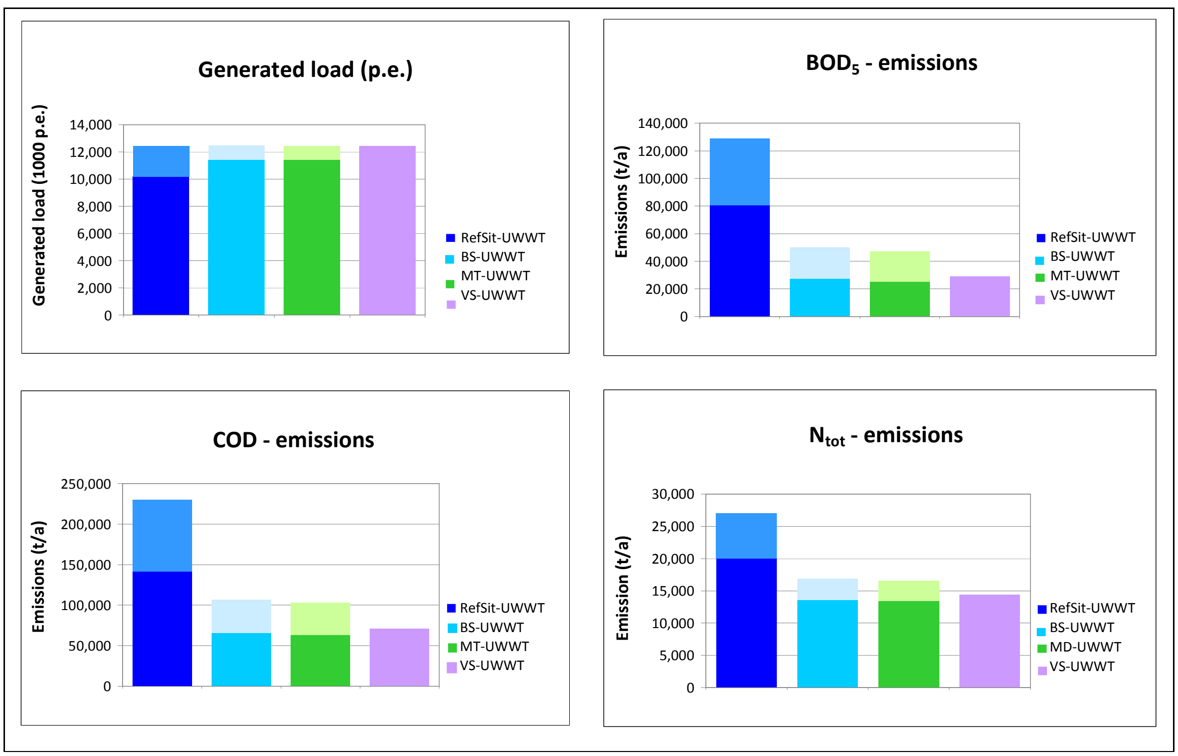
- **Vision scenario (VS-UWWT):** This scenario goes beyond the BS-UWWT and the MT-UWWT and therefore far beyond the requirements of UWWT Directive. It is based on the assumption that the full technical potential of wastewater treatment regarding the removal of organic influents and nutrients is exploited for both EU and Non EU MS. If such a scenario was to be realised, it is assumed that agglomerations >10,000 PE are equipped with N and P removal (secondary/tertiary wastewater treatment), whereas all agglomerations ≥2000 PE are equipped with secondary treatment.

1.1.3.2. Results of pressures assessment and of scenario calculations

Figure 3 summarises the emissions of BOD_5, COD, N_{tot} and P_{tot} as assessed for the different scenarios. In all scenarios, differentiation was made between emissions originating from agglomerations where at least part of the generated load is collected in a collecting system and treated in a wastewater treatment plant (darker coloured part of the columns) and emissions from agglomerations where the entire generated load is not collected in a collecting system (lighter coloured part of the columns). As, at the reference date 2005/2006, all Tisza River Basin countries were still using P-containing detergents, two versions of the future scenarios on P_{tot} emissions were calculated. One version assumed the further use of P-containing detergents in 2015, whereas the second approach assumed the use of P-free detergents.

For the reference date 2005/2006, 1078 agglomerations ≥2000 p.e were reported in the TRB, of which 892 agglomerations (3,718,167 p.e) were of the size class 2000-10,000 PE and 186 agglomerations (8,717,843 p.e.) had a size >10,000 PE. There were 22 agglomerations with a size of ≥100,000 PE, which produce about 38% of the total generated wastewater.

A considerable number of agglomerations (590), reflecting approx. 55% of the total generated load, are not connected to either a collecting system or treatment plant. Approximately 8% of the total generated load is collected in a collecting system but discharged without treatment. These two categories result in the highest discharged loads of BOD_5, COD, N_{tot} and P_{tot}, each contributing more than approx. 50% of respective loads. From the 22 agglomerations ≥100,000 PE (4, 694 million p.e.), 9 agglomerations (reflecting 23% of the generated load) have no wastewater treatment.



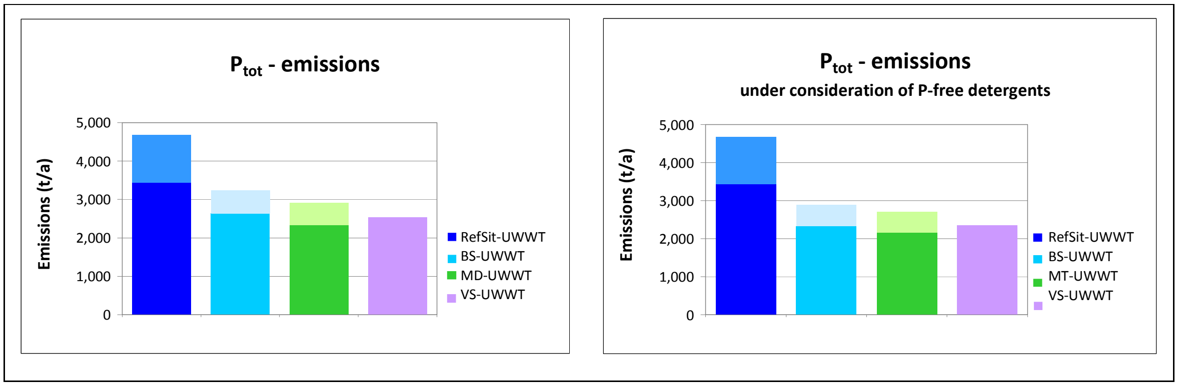


Figure 3: Emissions (t/a) of BOD_5, COD, N_{tot} and P_{tot} under different scenarios

Implementation of the *baseline scenario* would require the upgrade of wastewater treatment for 82 agglomerations in order to provide N and P removal for the entire generated load and also the establishment of secondary treatment for 269 agglomerations that are not served by any wastewater treatment, (partially) primary or (partially) secondary treatment, for the reference years 2005/2006.

Compared to the *reference scenario*, implementation of the *baseline scenario* emissions of BOD_5 would be reduced by 39% and emissions of COD by approx. 46%. For N_{tot} a reduction of 62% could be achieved, and for P_{tot} emissions, a 69% reduction.

The establishment of the *midterm scenario* would require the upgrade of wastewater treatment for 16 agglomerations in order to provide P removal for the entire generated load and also the provision of N and P removal for the entire generated load of 89 agglomerations. Compared to the *reference scenario*, these measures would decrease the emissions of BOD_5 by 36%, COD by 45%, N_{tot} by 52% and P_{tot} by 53%. Under the assumption of P-free detergent use in the entire TRB, the *midterm scenario* would decrease P_{tot} emissions by 52% compared to the *reference scenario*.

Finally, the implementation of the *vision scenario* would require the establishment of N and P removal for the entire generated load additional to those agglomerations identified for secondary treatment, N removal or P removal in the *midterm scenario*, and the provision of secondary treatment in an additional 592 agglomerations. Compared to the *reference scenario*, the emissions would be reduced by approx. 25% and 31% for BOD_5 and COD respectively, 52% for N_{tot} and 54% for P_{tot}. The stringent use of P-free detergents would decrease emissions of P_{tot} by 52%.

1.1.3.3. Presentation of results

The presentation of results was undertaken in the following way:

Presentation of the Reference Situation as of 31/12/2005 or 31/12/2006

For the presentation of the current situation regarding wastewater treatment, all agglomerations were attributed to the dominant treatment category according to the methodology described in this paper, and the emissions of BOD_5, COD, N_{tot} and P_{tot} were summarised for all pathways from the agglomeration (see Table 1).

Table 1. Overview of wastewater treatment in the TRB (reference date 31/12/2005 or 31/12/2006)

Tisza River Basin Reference Situation	Number of agglomerations	Generated load (p.e.)	Emissions BOD (t/a)	Emissions COD (t/a)	Emissions Ntot (t/a)	Emissions Ptot (t/a)
collected and other tertiary treatment	70	1,202,273	1,993	4,547	1,406	310
collected and tertiary treatment (3NP)	61	1,966,412	1,502	5,143	1,487	275
collected and tertiary treatment (3N)	15	983,535	1,077	4,883	1,008	187
collected and tertiary treatment (3P)	8	170,866	81	358	211	16
collected and partly other tertiary treatment	0	0	0	0	0	0
collected and partially tertiary treatment (3NP)	3	117,110	308	728	201	25
collected and partially tertiary treatment (3N)	5	58,703	737	1,465	129	22
collected and partially tertiary treatment (3P)	1	2,390	30	55	6	1
collected and secondary treatment	90	2,780,671	15,861	33,485	6,606	996
collected and partially secondary treatment	77	1,404,411	31,278	39,034	3,966	769
collected and primary treatment	9	205,616	2,285	4,763	850	108
collected and partially primary treatment	38	334,080	6,100	12,014	1,192	189
collected and treatment - total	***377***	***9,226,067***	***61,251***	***106,475***	***17,062***	***2,899***
collected and no treatment	111	967,348	19,673	35,465	2,943	542
not collected and not treated	590	2,242,595	48,043	88,079	7,046	1,243
Total	**1,078**	**12,436,010**	**128,967**	**230,020**	**27,051**	**4,683**

*Other more stringent treatment than N and/or P removal (e.g. chlorination, sand filtration, etc.)

The following example illustrates the methodology: 85% of agglomeration A (50,000 PE) was treated in a UWWTP with N and P removal, whereas the remaining fraction was discharged without treatment. Emissions of BOD_5 from the UWWTP providing N and P removal amounts to 9.8 t/a, whereas emissions from the fraction that is discharged without treatment amounts to 164 t/a. In the results table, agglomeration A is presented as follows:

	Number of agglomerations	generated load (PE)	Emissions BOD (t/a)	Emissions COD (t/a)	Emissions N_{tot} (t/a)	Emissions P_{tot} (t/a)
Collected plus more stringent treatment (3NP)	1	50,000	173.8			

It is always the highest treatment type that is considered in the results table (e.g. an agglomeration is treated by a UWWTP that provides primary and secondary treatment. The agglomeration is only counted once for secondary treatment and not for primary and secondary treatment).

<u>Overview agglomerations ≥100,000 p.e. in the TRB as at 31/12/2005 or 31/12/2006</u>

To present the wastewater treatment situation for agglomerations ≥100,000 PE, the absolute p.e. in the TRB amount entering the different wastewater pathways is illustrated (see Figure 1Figure 4).

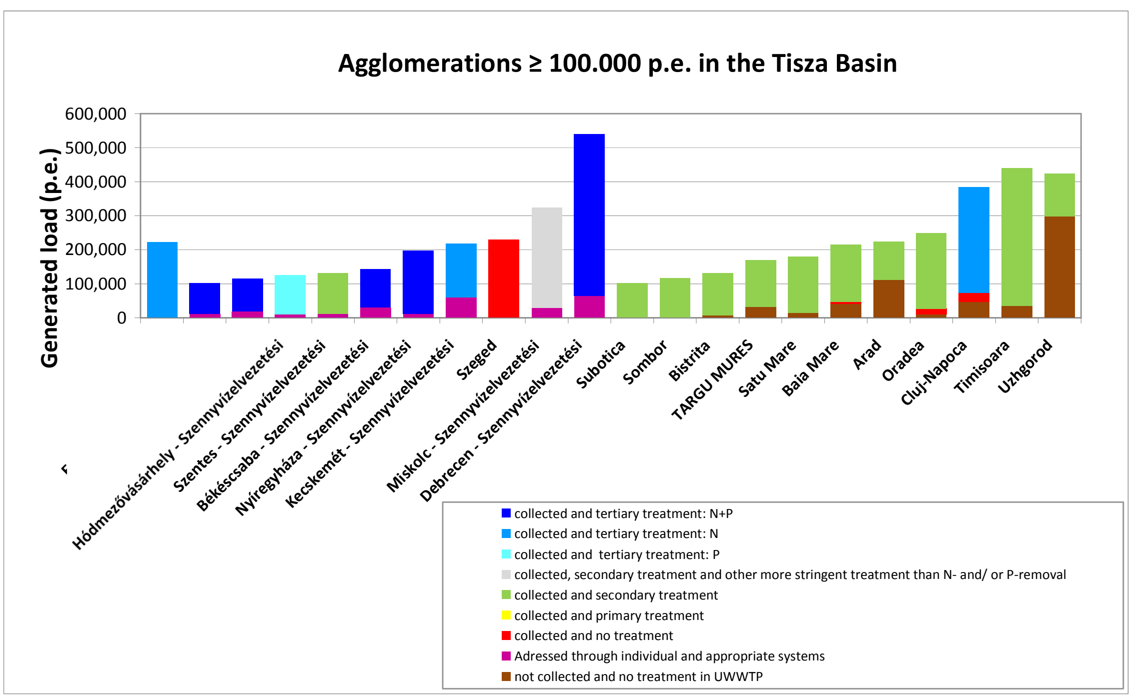


Figure 1: Overview of wastewater treatment in agglomerations ≥100,000 p.e. in TRB

1.1.3.4. Presentation of future scenarios for each country

For the presentation of future scenarios, the emissions to the environment from agglomerations ≥2000 p.e. are given separately for BOD_5, COD, N_{tot} and P_{tot}.

The figures (see example in Figure 5) represent the decrease in emissions due to improved wastewater treatment in 2015 in relation to the current situation (*reference scenario* = column 1). As it represents the *reference scenario*, the emissions reported for reference year 2005/2006 in column 1 always represent 100%. In each column, the emissions of BOD_5, COD, N_{tot} and P_{tot} are differentiated into emissions resulting from i) agglomerations where at least part of the generated load is collected in collecting systems (darker coloured parts of the columns), and ii) agglomerations where none of the generated load enters a collecting system (lighter coloured parts of the columns). The latter fraction reaches the environment as diffuse pollution and hence effects the aquatic environment of the TRB less directly than point sources. However, as the *agglomeration* including *all* generated loads represents the central concept of the Emission Inventory and as the collection of all wastewater in a collecting system is foreseen in Article 3 of Directive 91/271/EEC, this fraction is also presented in Figure 5.

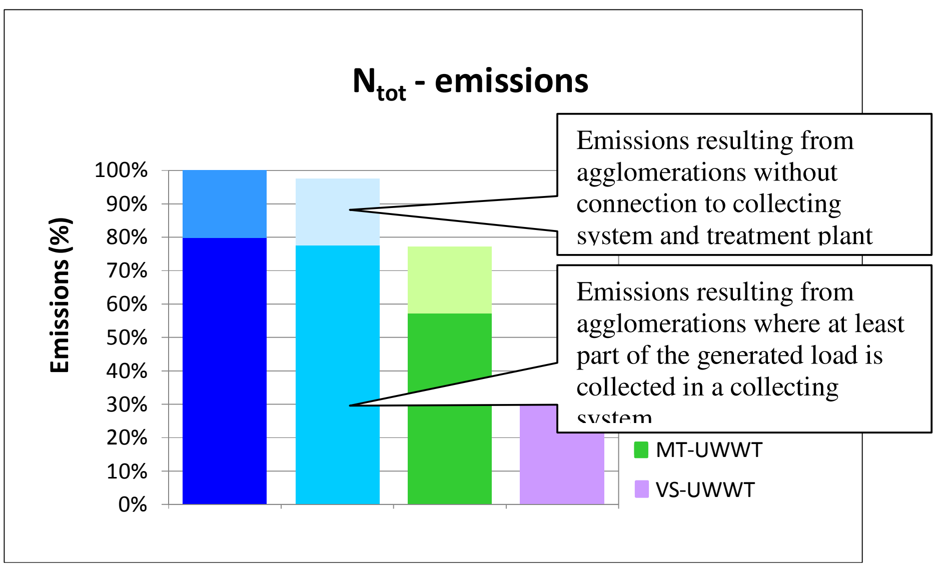


Figure 2: Example of the presentation of emissions under different scenarios

1.1.4. Results and conclusions

The results of pressures analysis and of future scenario for urban wastewater treatment in the TRB are presented by agglomerations served by each different treatment type, and in the Tables 2-5 are presented the annual emissions of BOD_5, COD, N_{tot} and P_{tot} from TRB agglomerations ≥2000 p.e. under consideration of each of the different scenarios. The Table 1 gives a rough overview of the present situation on wastewater treatment in the TRB, reflecting that in 2005/ 2006 there was still a high number of agglomerations (590) ≥2000 PE which were neither connected to a collecting system nor to a sewage treatment plant. In Tables 2, 3 and 4, the entire agglomeration and all associated emissions are allocated to the highest treatment type available.

Figure 3 summarises the influence of the different scenarios on emissions of BOD_5, COD, Ntot and P_{tot}.

All scenarios in Figure 3 differentiate between emissions originating from those agglomerations where at least part of the generated load is collected in collecting systems and emissions from agglomerations where the generated load is not collected in a collecting system. This differentiation was undertaken as emissions not yet collected in a collecting system do not directly enter surface waters. As they either drain into the ground or are used for agricultural purposes, they enter the aquatic environment mainly via groundwater. However, as the central object of the UWWT Directive is the agglomeration, emissions from the not collected fraction of wastewater were also considered in Figure 3.

As can be seen from Table 1, a total of 1078 agglomerations ≥2000 p.e. are located in the TRBD as reported for the reference date 2005/2006.

Of these, 892 agglomerations (3,718,167 p.e.) are of the size class 2000 PE–10,000 p.e and 186 agglomerations (8,717,843 p.e.) are >10,000 p.e. There are 22 agglomerations (4,694 million p.e.) larger than 100,000 p.e.

Around 13% of the total generated load is not connected to either a collecting system or treatment plant. The generated load of 44 agglomerations (753,975 p.e) where wastewater is collected in collecting systems but discharged without treatment amounts to approximately 60% of the total generated load.

Table 2: Baseline scenario: wastewater treatment in agglomerations ≥2000 p.e in the TRB and emissions of BOD_5, COD, N_{tot} and P_{tot} into the environment for 2015

Tisza Rire Basin **Baseline Scenario**	**Number agglom.**	**Generated load (p.e.)**	**Emissions BOD (t/a)**	**Emissions COD (t/a)**	**Emissions Ntot (t/a)**	**Emissions Ptot (t/a)**	**Discharged load Ptot - 1,5 g P/d (t/a)**
collected and other tertiary treatment	70	1,202,273	1,993	4,547	1,406	310	285
collected and tertiary treatment (3NP)	147	6,233,389	6,155	29,361	5,415	737	641
collected and tertiary treatment (3N)	13	376,275	239	1,071	191	73	71
collected and tertiary treatment (3P)	8	170,866	81	358	211	16	16
collected and partly other tertiary treatment	0	0	0	0	0	0	0
collected and partially tertiary	4	230,920	836	1,135	564	218	95

treatment (3NP)							
collected and partially tertiary treatment (3N)	2	16,406	18	99	16	6	6
collected and partially tertiary treatment (3P)	1	2,390	10	20	5	1	1
collected and secondary treatment	478	3,041,812	15,985	25,084	5,405	1,188	1,142
collected and partially secondary treatment	2	16,200	5	5	20	3	3
collected and primary treatment	0	0	0	0	0	0	0
collected and partially primary treatment	3	25,900	21	30	79	17	13
collected and treatment - total	***728***	***11,316,431***	***25,343***	***61,709***	***13,313***	***2,571***	***2,273***
collected and no treatment	9	108,350	2,352	4,317	279	65	57
not collected and not treated	341	1,033,927	22,461	41,179	3,294	601	562
Total	**1,078**	**12,458,709**	**50,157**	**107,206**	**16,886**	**3,236**	**2,891**

The *baseline scenario* (Table 2) describes the agreed measures for the first cycle of implementation of the WFD on the basin-wide scale until 2015. For the EU MS, it was assumed that Directive 91/271/EEC is implemented in the countries, as far as foreseen by the final deadlines or transitional periods for implementation. For the Non EU MS, improvements in wastewater treatment in 18 committed UWWTPs were taken into account (in Serbia 4 agglomerations and 14 agglomerations in Ukraine).

Compared to the *reference situation*, implementation of the *baseline scenario* would require the upgrade of wastewater treatment of 82 agglomerations in order to provide N and P removal for the entire generated load and the establishment of secondary treatment for 269 agglomerations that are not served by any wastewater treatment, (partial) primary or (partial) secondary treatment in the reference years 2005/2006.

The *baseline scenario* implies that 249 agglomerations that had not been connected to a collecting system in reference year 2005/2006, will be equipped with a collecting system, which means that the load entering wastewater treatment plants will significantly increase. In order to avoid a deterioration of the actual situation, it is therefore required to combine the establishment of collecting systems with the establishment of wastewater treatment plants, as shown in the *baseline scenario*.

However, under the *baseline scenario* there will still be a number of 341 agglomerations for which no collecting system is in place for the entire generated load and also for which a collecting system but no wastewater treatment is available for the entire generated load .

The improvement in wastewater treatment results in a clear shift in the relevance of the wastewater fraction not connected to collecting systems and/or wastewater treatment plants.

Table 3: Midterm scenario: wastewater treatment in agglomerations ≥2000 PE in the TRB and emissions of BOD_5, COD, N_{tot} and P_{tot} into the environment in 2015

Tisza River Basin MT-UWWT	**Number agglom.**	**generated load (p.e.)**	**Emissions BOD (t/a)**	**Emissions COD (t/a)**	**Emissions Ntot (t/a)**	**Emissions Ptot (t/a)**	**Discharged load Ptot - 1,5 g P/d (t/a)**
collected and other tertiary treatment	70	1,202,273	1,993	4,547	1,406	310	285
collected and tertiary treatment (3NP)	150	6,461,189	6,399	30,413	5,769	770	665
collected and tertiary treatment (3N)	13	376,275	239	1,071	191	73	71
collected and tertiary treatment (3P)	24	603,373	444	1,712	767	70	61
collected and partly other tertiary treatment	0	0	0	0	0	0	0
collected and partially tertiary treatment (3NP)	1	3,120	11	24	4	1	1
collected and partially tertiary treatment (3N)	2	16,406	18	99	16	6	6
collected and partially tertiary treatment (3P)	1	2,390	10	20	5	1	1
collected and secondary treatment	468	2,745,576	15,563	24,285	5,134	1,090	1,062
collected and partially secondary treatment	2	16,200	5	5	20	3	3
collected and primary treatment	0	0	0	0	0	0	0
collected and partially primary treatment	1	2,000	11	18	6	0	0
collected and treatment - total	***732***	***11,428,802***	***24,692***	***62,193***	***13,318***	***2,324***	***2,154***
collected and no treatment	7	26,361	557	1,154	77	14	12
not collected and not treated	339	1,003,545	21,796	39,960	3,197	581	545
Total	**1,078**	**12,458,709**	**47,046**	**103,307**	**16,592**	**2,919**	**2,711**

The *midterm scenario* (Table 3) reflects the situation where - in addition to the *baseline scenario* - P removal is supplied for all agglomerations >10,000 PE in Serbia and Ukraine. Compared to the *baseline scenario*, implementation of this scenario would require the upgrade of wastewater treatment for an additional 16 agglomerations in order to provide P removal for the entire generated load and also provision of N and P removal for the entire generated load of 3 agglomerations.

Finally, the *vision scenario* (Table 4) aims to present the results of the full use of the technical potential for wastewater treatment concerning the removal efficiencies of nutrients and goes beyond the treatment requirements for implementation of Directive 91/271/EEC. Compared to the *midterm scenario*, implementation of the *vision scenario* would require the establishment of N and P removal for the entire generated load of the 164 agglomerations that were considered with secondary treatment.

Table 4: Vision scenario: wastewater treatment in agglomerations ≥2000 PE in the TRB and emissions of BOD_5, COD, N_{tot} and P_{tot} into the environment in 2015 **VS-UWWT**

Tisza River Basin VS-UWWT	**Number agglom.**	**generated load (p.e.)**	**Emissions BOD (t/a)**	**Emissions COD (t/a)**	**Emissions Ntot (t/a)**	**Emissions Ptot (t/a)**	**Discharged load Ptot - 1,5 g P/d (t/a)**
collected and other tertiary treatment	39	201,601	390	802	276	59	45
collected and tertiary treatment (3NP)	214	8,880,751	8,256	38,525	7,371	1,046	916
collected and tertiary treatment (3N)	9	41,007	121	140	38	10	10
collected and tertiary treatment (3P)	0	0	0	0	0	0	0
collected and partly other tertiary treatment	0	0	0	0	0	0	0
collected and partially tertiary treatment (3NP)	1	3,120	11	24	4	1	1
collected and partially tertiary treatment (3N)	2	16,406	18	99	16	6	6
collected and partially tertiary treatment (3P)	7	37,180	31	118	39	6	4
collected and secondary treatment	806	3,278,643	20,315	31,302	6,612	1,411	1,368
collected and partially secondary treatment	0	0	0	0	0	0	0
collected and primary treatment	0	0	0	0	0	0	0
collected and partially primary treatment	0	0	0	0	0	0	0
collected and treatment - total	***1,078***	***12,458,709***	***29,142***	***71,010***	***14,356***	***2,539***	***2,350***

collected and no treatment	0	0	0	0	0	0	0
not collected and not treated	0	0	0	0	0	0	0
Total	**1,078**	**12,458,709**	**29,142**	**71,010**	**14,356**	**2,539**	**2,350**

The effects of the implementation of the different future scenarios are presented in the Figure 3. Under consideration of the *baseline scenario,* emissions of BOD_5 could be reduced by 39% and emissions of COD by around 46%. For N_{tot}, a substantial reduction of 62% could be achieved and the reduction of P_{tot} emissions would amount to 69%. When additionally taking into consideration the use of P-free detergents in the entire TRB, the reduction of P_{tot} emissions would not increase the reduction of P_{tot} emissions.

Compared to the *reference scenario*, implementation of the *midterm scenario* would decrease the emissions of BOD_5 by 36%, COD by 45%, N_{tot} by 52% and P_{tot} by 53%. Under the assumption of the use of P-free detergents in the entire TRB, the *midterm scenario* would decrease P_{tot} emissions by 52%.

Finally, the implementation of the *vision scenario* would require the establishment of N and P removal for the entire generated load additional to those agglomerations identified for secondary treatment, N removal or P removal in the *midterm scenario.* Compared to the *reference scenario*, the emissions would be reduced by approx. 22% and 31% for BOD_5 and COD respectively, 52% for N_{tot} and 54% for P_{tot}. The stringent use of P-free detergents would decrease emissions of P_{tot} by 52%.

1.2. Organic pollution from industry and agro-industry

1.2.1. Basic concept

Annex VI of the Water Framework Directive (WFD) stipulates that the Programmes of Measures should include measures under the 96/61/EC Integrated Pollution Prevention Control (IPPC) Directive. The EU set of common rules for permitting and controlling industrial installations in the IPPC Directive (Directive 1996/61/EC) aims to minimise pollution from various industrial sources throughout the EU. The permit conditions, including emission limit values, must be based on Best Available Techniques (BAT). This has resulted in the adoption and publication of the BAT Reference Documents (the so-called BREFs) by the ICPDR. The purpose of the Directive is to ensure a high level of protection of the environment taken as a whole.

The IPPC Directive is considered to be the most significant challenge facing the industrial sector in recent years and in the future. Pollution coming from point industrial units is partly addressed by the IPPC and partly by a number of specialised directives covering specific sectors. The IPPC Directive takes an integrated approach, which means that authorities need to take into account: transboundary effects, costs and advantages of pollution prevention and control and the best available techniques reference documents.

The main reporting requirement of the IPPC is the publication of an inventory of chemical emissions and sources called the European Pollutant Emission Register (EPER). It was established by Commission Decision 2000/479/EC to implement the provisions of article 15 (3) of the IPPC Directive on public accessibility of the results of monitoring. EPER requires reporting from all installations that fall under the IPPC. It covers 50 air and water pollutants and the data is reported on the basis of threshold limit values of parameters. In EPER, emission data reported by EU Member States (EU MS) are made accessible in a public register that is intended to provide environmental information on major industrial activities. As of 2007, EPER has been replaced by the European Pollutant Release and Transfer Register (E-PRTR).

The EPER is considered to be an effective tool for monitoring releases from larger industrial facilities and for comparing releases from similar industrial sources or sectors. Not all existing industrial plants are considered for EPER reporting – only those activities which are listed in Annex A3 of the EPER Decision are included.

IPPC Annex I activities	
1.	Energy industries
1.1	Combustion installations > 50 MW
1.2	Mineral oil and gas refineries
1.3	Coke ovens
1.4	Coal gasification and liquefaction plants
2.	Production and processing of metals
2.1/2.2/2.3/ 2.4/2.5/2.6	Metal industry and metal ore roasting or sintering installations; installations for the production of ferrous and non-ferrous metals
3.	Mineral industry
3.1/3.3/3.4/ 3.5	Installations for the production of cement klinker (>500t/d), lime (>50t/d), glass (>20t/d), mineral substances (>20t/d) or ceramic products (>75t/d)
3.2	Installations for the production of asbestos or asbestos-based products
4.	Chemical industry and chemical installations for the production of:
4.1	Basic organic chemicals
4.2/4.3	Basic inorganic chemicals or fertilisers
4.4/4.6	Biocides and explosives
4.5	Pharmaceutical products
5.	Waste management
5.1/5.2	Installations for the disposal or recovery of hazardous waste (>10t/d) or municipal waste (>3t/h)
5.3/5.4	Installations for the disposal of non-hazardous waste (>50t/d) and landfills (>10t/d)
6.	Other Annex I activities
6.1	Industrial plants for pulp from timber or other fibrous materials and paper or board production (>20t/d)
6.2	Plants for the pre-treatment of fibres or textiles (>10t/d)
6.3	Plants for the tanning of hides and skins (>12t/d)
6.4	Slaughterhouses (>50t/d), plants for the production of milk (>200t/d), other animal raw materials (>75t/d) or vegetable raw materials (>300t/d)
6.5	Installations for the disposal or recycling of animal carcasses and animal waste (>10t/d)

6.6	Installations for poultry (>40,000), pigs (>2000) or sows (>750)
6.7	Installations for surface treatment or products using organic solvents (>200t/y)
6.8	Installations for the production of carbon or graphite

Table 5: List of activities with production capacity relevant for EPER reporting

According to the EPER Decision, there are 26 pollutants selected for reporting for water with a specified threshold value for each of the substances. The threshold values have been chosen in order to include about 90% of the emissions of the industrial facilities looked at, so as to prevent an unnecessarily high burden on all industrial facilities.

No.	Pollutant name	Threshold values for releases (in kg/y)
1	Total nitrogen (N)	50,000
2	Total phosphorus (P)	5000
3	Arsenic and compounds (as As)	5
4	Cadmium and compounds (as Cd)	5
5	Chromium and compounds (as Cr)	50
6	Copper and compounds (as Cu)	50
7	Mercury and compounds (as Hg)	1
8	Nickel and compounds (as Ni)	20
9	Lead and compounds (as Pb)	20
10	Zinc and compounds (as Zn)	100
11	Dichloroethane – 1,2 (DCE)	10
12	Dichloromethane (DCM)	10
13	Chloro-alkanes, C10-C13	1
14	Hexachlorobenzene (HCB)	1
15	Hexachlorobutadiene (HCBD)	1
16	Hexachlorocyclohexane(HCH)	1
17	Halogenated organic compounds (as AOX)	1000
18	Benzene, toluene, ethylbenzene, xylenes (as BTEX)	200
19	Brominated diphenylethers (PBDE)	1
20	Organotin compounds(as total Sn)	50
21	Polycyclic aromatic hydrocarbons (PAHs)	5
22	Phenols (as total C)	20
23	Total organic carbon (TOC) (as total C or COD/3)	50,000
24	Chlorides (as total Cl)	2,000,000
25	Cyanides (as total CN)	50
26	Fluorides (as total F)	2000

Table 6: List of pollutants to be reported if threshold values are exceeded

The reporting of the EU MS in the TRB served as basis for reporting on and assessing the industrial wastewater assessment.

1.2.2. Methodology

The methodology for assessing industrial pollution in the TRB is based on the same approach as for the Danube River Basin Management Plan. It covers the reporting of EU MS to EPER and separate reporting of non EU countries using the same templates as for the EU MS. In 2007, the ICPDR Municipal Emission Inventory was modified in a way to be consistent with the collection of data under the EPER Decision. The methodology for reporting on industrial discharges allowed the separation of reporting only to water (direct and indirect discharges) from the reporting for emissions into the air and land. Thus, the new database will allow the identification of how much of a certain chemical from a certain facility has been discharged into water.

For the purposes of identification of industrial point sources of pollution in the TRB, the data from EU MS and non Member States (non EU MS) that have been reported for the Danube share have been checked and adjusted for the Tisza share in each of the Tisza countries. To facilitate reporting on the measures addressing industrial discharges, information on basic measures were included in the templates for data collection for the status of IPPC/BAT or ICPDR/BAT implementation.

A combined template was designed to provide information on the sources of pollution from industrial facilities in Tisza River Basin countries to water – both direct and indirect discharges, which included:

General information: report ID, reference date and contact person

This sheet provided general, related information on competent authority and person responsible for reporting in the country and contact details.

In addition, in order to gain information on the required measures, a table was included with the aim of specifying the number of sites where measures are needed and their estimated costs.

Country-based (Danube part) information		
Number of facilities where measures are needed in compliance with the IPPC/BREF (where transitions periods exist)	Number	
Estimated overall costs associated with the measures at those facilities	Million Euro	

Facilities: name of the facility, ID of the facility, address, coordinates

The sheet contains full information on industrial facilities carrying out one or more of the E-PRTR activities. The parent company is a company that owns or controls the company operating the facility (for example by holding more than 50% of the company's share capital or a majority of voting rights of the shareholders or associates). Each facility is listed with its identification name and number. Address, coordinates of the location and main economic activity are listed, using a drop down list of NACE code activities.

In addition, for EU MS, information is included on the existence of an IPPC permit for the facility; whether the facility is in compliance with IPPC/BREF with regard to wastewater emissions; and if it is not BAT compliant within the reporting deadline, whether there are plans for the facility to be compliant with the IPPC/BREF by 2015.

For non EU MS, this template gives a general overview of whether the installation is in compliance with the ICPDR BAT recommendation and, if it is not compliant at the reporting deadline, information on whether it is planned that the facility be in compliance with the ICPDR BAT by 2015.

Direct releases to water

This sheet is connected with general information on the facilities via the facility ID code. The sheet indicates the value of loads due to direct discharges to water. Reported releases to water of any pollutant specified for which the applicable threshold value is exceeded, are reported. All releases are expressed in kg/year. The reported release data must include reference to the determination of methodology used for the reported release data: M (measured), C (calculated) or E (estimated).

Any data that relate to the accidental releases are also specified. The quantity of accidental releases is included in the total quantity of releases (example: accidental release = 1 kg/y, routine release = 10 kg/y, total release = 11 kg/y). In addition, information on the river basin district and ID of the receiving water body are requested.

Indirect releases to water

The off-site transfers of any pollutant specified in Table 6 for which the threshold value is exceeded are also reported. All facilities and pollutants emitted indirectly to water and exceeding threshold values are listed in the table. An off-site transfer of pollutants in wastewater means the movement beyond the boundaries of a facility of pollutants in wastewater destined for wastewater treatment (including industrial wastewater treatment). The off-site transfer may be carried out via sewer or any other means such as containers or tankers.

Total emissions

In this sheet, all pollutants specified by the separate activities in the Tisza territory of the country within the TRB are summarised.

1.2.3. Results

For the purpose of the development of a complete overview of emission inventories for industrial sources, data on industrial discharges for EU MS countries in the Danube Basin were downloaded from the EPER II web site in Access format for the years 2004 (Slovakia and Hungary) and 2005 (Romania). As these data were related to the Danube share, the values were adjusted for the Tisza basin in each of the Tisza countries. In addition, all Tisza countries were asked to fill in the designed templates with data on industrial facilities, emissions to water, compliance with the European legislation and ICPDR BAT.

To facilitate the integrated overview of the results, the reported facilities are considered to have direct discharges to water. As the respective activities are not specified for all countries in the TRB, the number of activities is not presented as a table.

Table 7 presents the results of the Tisza countries reporting in line with the EPER Decision, on both direct and indirect discharges into water for the years 2001 to 2006. There are a total number of 95 facilities emitting into water in the reference year 2006.

	HU	SK	RO	RS	UA	Total
Total No of facilities in 2006	46	28	19 of which 2	To be reported	2	95

			are closed			
No of facilities in compliance with the IPPC/BREF by 2015	41	28	19		2	90
No of facilities which are not in compliance with IPPC/BREF recommendations in 2006	13	5	8		2	28
No of facilities where measures are needed		5	12		2	19

Table 7 Industrial facilities reported for each Tisza country (reference year 2006).

2. Nutrient pollution

2.1. Basic concept

Nutrient pollution comprehends mainly pollution from phosphorus and nitrogen input. Point and diffuse source discharges are to be distinguished. Point source discharges are caused by single activities and are locally confined, whereas diffuse source discharges are caused by widespread activities like agriculture with multiple undifferentiated sources.

The levels of diffuse pollution are not only dependent on anthropogenic factors such as land use and land use intensities, but also on natural factors such as climate, flow conditions and soil properties. These factors influence the pathways of the diffuse nutrient emissions and the retention and losses on the way from the origin to the inputs into the river system.

Whereas the load of substances from point discharges can be measured or calculated from measured concentrations and flows, the emissions of substances from diffuse sources cannot be measured and are difficult to define.

The loads estimation of diffuse source pollution in the TRB is using the same concept and methodology as for the Danube pressures analysis, respectively mathematical modeling. Thus, in the frame of the TRB, nutrient emissions into the river system through individual pathways were estimated through MONERIS (MOdelling Nutrient Emissions in RIver Systems) model. The model used land use, hydrological, soil and hydrogeological data collected in a Geographical Information System (GIS) as well as statistical information for different administrative levels.

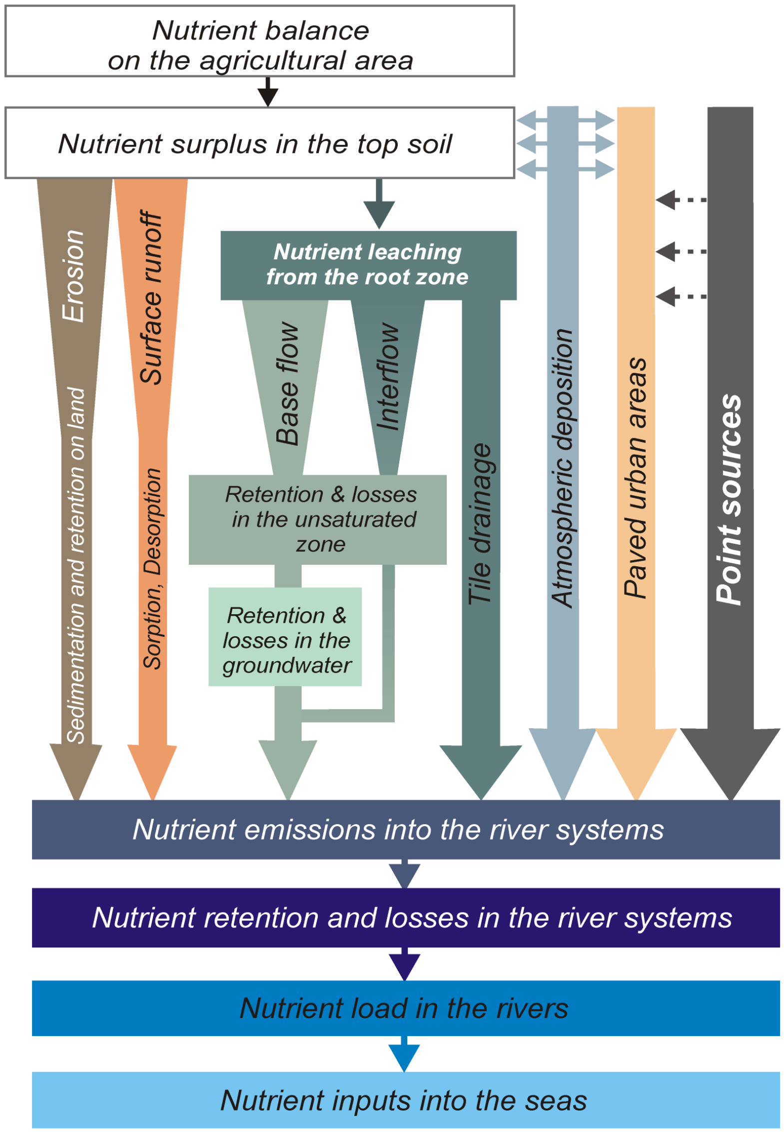
2.2. Methodology: MONERIS model

The emission model MONERIS uses spatially and temporally varying input data regarding the natural system and human activities in the TRB. This comprises among other factors data on: soil characteristics, meteorological factors, land use, population and degree of urbanisation, connection to sewerage systems and degree of wastewater treatment, N surplus on agricultural soils, P accumulation in soils and atmospheric deposition. It uses this information to calculate the emissions of N and P to surface water, by seven different pathways. The results can be shown as tables and maps.

The pathways are:

1. Point sources (wastewater treatment plants and industry);
2. Overland flow;
3. Ground water flow;
4. Tile drainage;
5. Erosion;
6. Urban systems;
7. Atmospheric deposition on surface waters.

The MONERIS model (see Figure 6) was developed to estimate nutrient inputs by point and various diffuse sources into rivers with catchments on a larger scale. The model uses Microsoft Access databases. The average size of basic catchments (analytical units) used in the Tisza River Basin calculations is 2000 km², but based on data availability and required detail level, can be reduced to approx. 100 km² or even lower.



MONERIS was also conceived as a system for identifying reduction needs to meet applicable water quality standards (target concentrations) by using different scenario options. It is also used to examine a number of scenarios to demonstrate impacts of reducing wastewater loads alone and in combination with measures to reduce diffuse inputs for phosphates e.g. through the use of P-free detergents.

Figure 6. MONERIS model for estimating inputs of nutrients into river systems

For the use of MONERIS for the Danube, a complete new version of the model was developed which was used for Tisza River Basin as well. Besides implementation of new scientific approaches regarding retention of nutrients in the river system and erosion, the model now has a user interface (see Figure 7). This allows access to the model at different levels. Modellers can change input data and viewers can select results of the calibrated model for selected years and calculate scenarios. The user interface includes the calibrated model for the TRB as well; the scenario manager for certain measures in the field of agricultural, urban and wastewater treatment plants; the possibility to present results for selected years as figures and tables and the export functions to use the model results within further work.

For the MONERIS upgrade of the Danube, a manual was developed that will be published and used as well by the experts in the Tisza countries. This manual includes a detailed description of the methodology and a description of how to use the user interface, as well as maps and data used as input data for the TRB modelling.

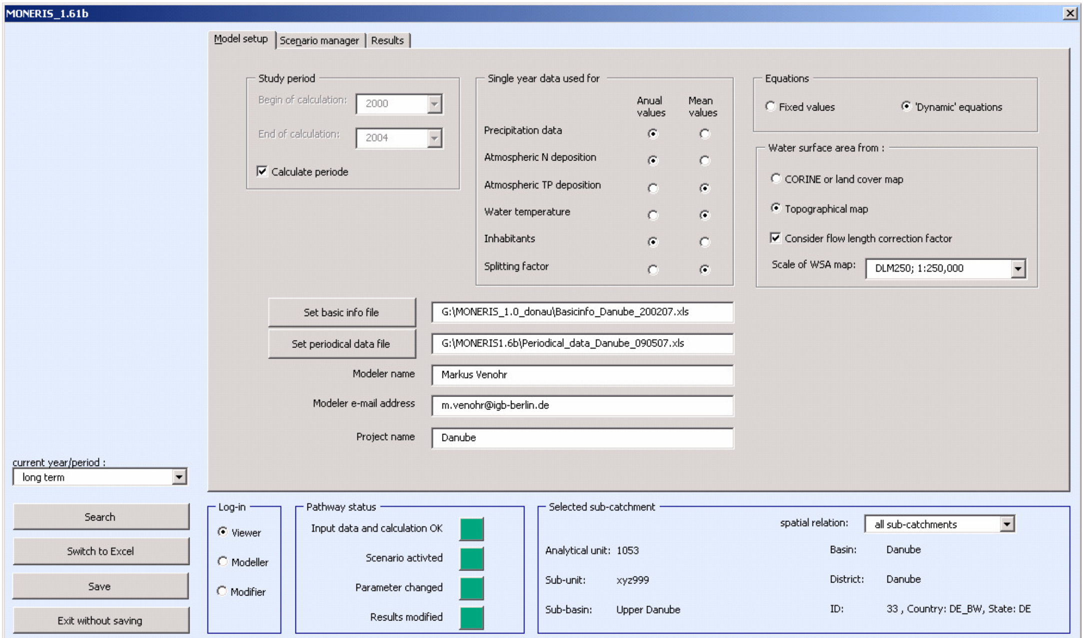


Figure 7 MONERIS model interface

The development of the model MONERIS in 2008 - 2009 contributed to the development of a decision support and management tool based for pollution control in the development of River Basin Management Plans.

The modelling and data processing at present is mainly focused on modeling the input process (the pathways) with available data.

According to the list of possible measures for reducing and controlling pollution coming from point discharges and diffuse emissions of nutrient and other substances, the model has been improved so scenarios for a set of different measures can be calculated for the total Danube basin as well as for individual sub basins as Tisza or countries. This is especially important in the case of nutrients where the cumulative effects of all inputs were observed in the coastal areas of the Black Sea.

Further, the MONERIS model is using a new approach for the retention of nutrients which allows the differentiation between the retention in the sub-catchment and along the main river stretches.

2.2.1. MONERIS Scenarios calculation

The selection of scenarios at the Tisza River Basin district level relates to the overall approach being taken at the key, upper level of river basin planning, which is currently being made in relation to the Danube River Basin District (DRBD).

Scenarios with different environmental benefits due to nutrient reduction measures in line with EU policies (basic/supplementary measures) and the related timetable of individual countries (respecting agreed transitional periods) are designed and evaluated though MONERIS investigations.

Through the MONERIS model, the nutrient loads within the river network of the TRBD are calculated for the present state and different future scenarios for 2015.

2.2.2. Scenario for nutrient reduction

Scenarios with different environmental benefits due to nutrient reduction measures and the related timetable of individual countries (respecting agreed transitional periods) are designed and evaluated though MONERIS. Through the model, the nutrient loads within the river network of the TRB are calculated for the present state and for various different scenarios for 2015.

The requirements and objectives of the WFD are to achieve good ecological status by 2015 for all waters. The RBMP will provide the context for setting out a comprehensive programme of measures designed to achieve the objectives set for water bodies.

The measures addressing three of the identified Significant Water Management Issues (SWMI), (namely organic pollution, nutrient pollution and hazardous substances pollution) are strongly interlinked. The selected approach recognises these synergies in the development of the packages of measures in the JPM. For example, the effects of management decisions for urban wastewater development addressing organic pollution have certain positive effects on nutrient reduction in the respective area. These effects - benefits and drawbacks - must be identified and evaluated under different scenarios and based on a wide range of options for development and underlying assumptions that are taken into account and evaluated.

2.2.2.1. Methodological approach

The methodology used for the purpose of the TRBM Plan is similar with the one used for the DRBMP, with an additional scenarios considered for the wetland creation and reconnection.

The methodology that consists of four major steps:

(i) set out the assumptions for possible developments regarding various sectors,

(ii) develop scenarios by combining different sets of assumptions,

(iii) map assumptions into load reductions and, in the case of nutrient emissions, into input parameters for MONERIS, and

(iv) perform scenario assessments and nutrient scenario calculations with MONERIS using the relevant parameters.

<u>Setting out assumptions for possible developments regarding various sectors</u>

The assumptions are coherent extrapolations of immediate or medium-term implementation effects of different policy options, such as the implementation of EU or national legislation, changes in agricultural policies etc.

For the baseline scenario (BLS), which describes developments (considering current, ongoing or planned measures), the assumptions have to be selected accordingly. Specific assumptions to policy related drivers selected for the TRB have been used as well for the TRB.

The assumption related to the use of fertilisers are based on the European Fertilizer Manufacturers Association (EFMA) which assumes an increase in application rates for N fertilizer for the new EU MS of approx. 20% for 2017 (EFMA, 2008). The EFMA forecast also includes values for individual Tisza countries: Hungary (+20%) and Romania (+24%).

For the projection of fertilizer application in other Danube countries, we used the EFMA average of a 20% increase.

Development of scenarios by combining different sets of assumptions

The combination of the various assumptions conceptualises the respective scenarios. The definition of scenarios is a complex procedure that needs assessment and integration of all interlinkages between those policies and assumptions affected by a particular decision or commitment. Building different scenarios on a range of plausible assumptions provides the basis for a discussion about their effects and is a key element in decision support.

In the context of the strategic planning and decision support for the development of the JPM, the scenarios provide a setting to discuss various options and have the value of offering the CPs an opportunity for dialogue about their respective perspectives on plausible future developments for the successful implementation of the measures.

Mapping assumptions into load reductions and, in the case of nutrient emissions, into input parameters for MONERIS

After having agreed conceptually on the various scenarios, the influence of various scenarios and measures in the TRB has been assessed as a quantitative effect.

Performing scenario assessments and nutrient scenario calculations with MONERIS using relevant parameters

All previous steps are used to define measures and to combine the modelling of different measures or packages of measures. In order to facilitate the nutrient pollution analysis, the scenarios are calculated based on modelling - for the TRB countries, the MONERIS model is used. The overall application of MONERIS allows a regionally differentiated quantification of nutrient emissions via different pathways describing point and diffuse sources discharging into river systems.

3. Hazardous substances pollution

3.1. Basic concept

Main point sources of hazardous substances of TRB are industrial effluents, storm water overflow and discharges from mining sites.

The lack of data on hazardous substances is caused mostly by the deficiency of adequate analytical instrumentation and by the absence of legal instruments for obligatory measurements. There is a large amount of uncertainty in our current knowledge of pressures due to hazardous substances and water status.

The pressures refinement was based on the updated reporting of countries in the emission inventories on priority hazardous substances as well on hazardous substances, both discharging into surface water and sewage systems.

In order to avoid duplication of work and to ensure the coherence of the inventory with other existing tools in the area of surface water protection, information collected under the WFD and under Regulation European Pollutant Release and Transfer Register and amending Council Directives 91/689/EEC and 96/61/EC has been used.

Manufacturing industries are responsible for large emission loads regarding various determinands of which for example heavy metals, organic pollutants and organic matter. Information provided by the three MS in the TRB on EPER reporting shows an increase of the reported loads values of As, Cd, Cr, Cu, Hg, Ni, Pb and Zn in 2004, compared with the 2001 values.

3.2. Use of agricultural pesticides in the TRB

Data from the FAOSTAT database show a strong decline in pesticide use in the CEE countries to about 40% of 1989 levels compared to a relatively small decrease in EU Member States during the same period. An additional source of information on pesticide use within the Danube countries for the Danube Analysis is the report “Inventory of Agricultural Pesticide Use in the DRB Countries”. The data assessment has shown that 29 chemicals are used in the Danube River Basin in pesticide products. Of these only three priority pesticides are authorized for use in all of the DRB countries, while seven priority pesticides are not authorized in any of the countries.

An overall estimation of pesticide use in the TRB is not possible. Large data limitations, however, impeded a realistic simulation of reality.

3.3. Accidental pollution and the inventory of accident risk spots in the TRB

Experiences with consequences due to several accidental spills of toxic contaminants into water has shown that inadequate application of precautionary measures at accident risk spots

(ARS) could lead to harmful effects to humans as well as to the environment. For this reason the ICPDR elaborated a basin-wide inventory of potential accident risk spots (ARS Inventory). For estimation of a real risk at a particular site a set of checklists was elaborated and made available to the Danube countries.

For the classification of potential risk spots, a common procedure was elaborated considering European regulations and findings: the findings of the ICPE, the EU „Seveso II“ directive, and the „UN/ECE agreement on the effects of industrial accidents (Industrial accident Convention).

In addition to the ARS inventory, the experts of the Danube countries updated a compilation of abandoned sites (261 contaminated sites) supposed to be contaminated by former industrial activities or waste disposal initiated in 2002.

Based on these data a methodology (M1) for the pre assessment was elaborated, which can be used as a screening tool for suspected contaminated sites with regard to their risk potential. Sites with a high risk potential should be investigated further in view to create a more concrete risk estimation and ranking. Based on that estimation it is possible to elaborate a list of necessary immediate measures to enhance the safety level of the site. The selected M1 methodology for risk identification considers the properties of substances used, or stored, at a site and the quantity of the given substances. The properties of the substances determines the Water Risk Class (WRC) which – in combination with the amount of the used, stored substances – determines the Water Risk Index (WRI), the quantitative indicator of the risk.

About 650 risk spots were recorded and 620 were evaluated. As a result it could be identified a hazardous equivalent of about 6,6 Mio tons in the Danube catchment area as a potential danger.

Sites contaminated as a result of industrial activities represent a potential danger for the environment. This is especially true of those sites contaminated by hazardous substances which could be mobilised and enter water bodies in the event of a flood.

For all sites with an initial risk value (M1-value) equal or higher 50 a further investigation is necessary. Therefore the M2 methodology was developed, which gives information if further safety measurements to lower the risk at the sites are needed. The M2 methodology considers the M1-value (initial risk value), a factor of flooding potential at the site (FP) and a factor of safety measures at the site (SM).

The updated inventories may provide a clear picture on the potential risk sites as well of the possible targets to reduce and control accidental pollution.

Conclusions

There is a large amount of uncertainty in our current knowledge of pressures due to hazardous substances and water status. The usage of pesticides dropped significantly after the collapse of the economic systems in almost all Danube countries in the early 1990s.

It is also expected that the population and industrial growth will lead to a greater discharge of hazardous substances to company sewers

Results of on going screening at the national level show progress and efforts of the countries to establish comprehensive inventories of all relevant substances from the groups and families of dangerous substances in List II to the Annex of the Directive 76/464/EEC, as amended by WFD. The results will be further used in the development of legally binding pollution reduction programme that need to be collectively implemented by the installations operating in the specific water basin district in accordance with the timetable specified in WFD.

As part of current work of harmonization with existing pollution emission reporting systems used in the EU, the ICPDR will finalise an overall strategy for data management on sources, releases and loads of priority pollutants, based on "Emission Strings” (according to the NOSE and NACE classification codes), compilation of information on priority pollutants, and further work on the identification of chemicals listed in the WFD (PS/PHS) and the EQS proposal. This would allow integration of collected priority pollutants information on sources, releases and loads, potential mitigation options, emissions into the environment, etc. A future challenge would be to connect the developed data management system with MONERIS modelling.